

CLAIMS

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1. A non-woven fibre web comprising a plurality of fibres in the x- and y-directions of average length greater than 5mm ("longer fibres") and a plurality of fibres of average length less than 3mm ("shorter fibres") wherein at least a proportion of the fibres of average length less than 3mm are orientated in the z-direction, and wherein the proportion of fibres of average length less than 3mm is at least 20% of the total weight of fibres, and wherein the density of the non-woven fibre web is from 0.1g/cm<sup>3</sup> to 0.35g/cm<sup>3</sup>.
2. A non-woven fibre web comprising up to and including 80% by weight of fibres in the x- and y-directions of average length greater than 5mm ("longer fibres"), and 20% or more by weight of fibres of average length less than 3mm ("shorter fibres") wherein at least a proportion of the fibres of average length of less than 3mm are orientated in the z-direction, and wherein the density of the non-woven fibre web is from 0.1g/cm<sup>3</sup> to 0.35g/cm<sup>3</sup>.
3. A non-woven fibre web according to claim 1 or claim 2 wherein the proportion of shorter fibres is suitably no more than 85% by weight of total fibres in the substrate.
4. A non-woven fibre web according to claim 3 wherein the proportion of shorter fibres is suitably no more than 70% by weight of the total fibres.
5. A non-woven fibre web according to any of claims 1 to 4 wherein the longer fibres suitably have a maximum average length of 50mm.
6. A non-woven fibre web according to claim 5 wherein the longer fibres are of average length of 5mm to 30mm.
7. A non-woven fibre web according to any preceding claim wherein the shorter fibres are of average length less than 2mm.

8. A non-woven fibre web according to claim 7 wherein the shorter fibres are of average length less than 1mm.

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5 9. A non-woven fibre web according to any preceding claim wherein the shorter fibres have an average minimum length of 50µm.

10. A non-woven fibre web according to any preceding claim wherein the longer fibres and shorter fibres are independently selected from the group consisting of carbon, glass, silica, polymer, metal and ceramic fibres.

10 11. A non-woven fibre web according to claim 10 wherein the longer fibres and shorter fibres are carbon.

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15 12. A non-woven fibre web according to any preceding claim wherein the density of the non-woven fibre web is from 0.1g/cm<sup>3</sup> to 0.2g/cm<sup>3</sup>.

13. A process for the preparation of a non-woven fibre web according to any preceding claim, said process comprising the steps of:

- 20 (i) dispersing the longer and shorter fibres in solution to form a slurry;  
(ii) adding one or more polymers (the "first polymer") to the slurry;  
(iii) draining the liquid from the slurry to form a web, or forming a continuous structure by the controlled deposition of the slurry onto a moving bed mesh;  
(iv) drying the web;  
(v) optionally placing the web in a solution of polymer (the "final polymer");  
25 (vi) drying the web; and  
(vii) heat treating the web.

30 14. A gas diffusion substrate comprising a non-woven fibre web as claimed in any one of claims 1 to 12, and a filler material.

15. A gas diffusion substrate according to claim 14 wherein the filler material comprises particulate carbon and a polymer.

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*A5* → 16. A gas diffusion substrate according to claim 14 or claim 15 wherein the filler material comprises a catalyst material.

17. A gas diffusion electrode comprising a gas diffusion substrate as claimed in any  
5 one of claims 14, 15 and 16, and an electrocatalyst material.

18. A gas diffusion electrode according to claim 17, wherein the electrocatalyst material comprises one or more electrocatalytic components and a polymer.

10 19. A gas diffusion electrode according to claim 18, wherein the electrocatalyst material is a precious metal or a transition metal as the metal or metal oxide, either unsupported or supported in a dispersed form on a carbon support; a carbon or an organic complex, in the form of a high surface area finely divided powder or fibre, or a combination of these options.

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*A6* → 15 20. A membrane electrode assembly comprising a gas diffusion electrode as claimed in any one of claims 17, 18 and 19, a second gas diffusion electrode which may or may not be an electrode as claimed in any one of claims 17, 18 and 19, and a solid polymer membrane.

20 21. A membrane electrode assembly comprising a gas diffusion electrode as claimed in any one of claims 17, 18 and 19, a gas diffusion substrate which may or may not be a substrate as claimed in any one of claims 14, 15 and 16, and a solid polymer membrane, wherein an electrocatalyst layer is applied to the side of the membrane facing the gas  
25 diffusion substrate.

30 22. A membrane electrode assembly comprising a gas diffusion substrate as claimed in any one of claims 14, 15 and 16, a gas diffusion electrode which may or may not be an electrode as claimed in any one of claims 17, 18 and 19, and a solid polymer membrane, wherein an electrocatalyst layer is applied to the side of the membrane facing the gas diffusion substrate.

23. A membrane electrode assembly comprising a gas diffusion substrate as claimed in any one of 14, 15 and 16, and a second gas diffusion substrate which may or may not be a substrate as claimed in any one of claims 14, 15 and 16, and a solid polymer membrane, wherein an electrocatalyst layer is applied to both sides of the solid polymer membrane.

24. A fuel cell comprising a gas diffusion substrate as claimed in any one of claims 14, 15 and 16.

25. A fuel cell comprising a gas diffusion electrode as claimed in any one of claims 17, 18 and 19.

10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100